

**FY 2012 Healthy Homes Technical Studies  
Notice of Funding Availability**

**APPENDIX A – Key Residential Health and Safety Hazards**

The following briefly describes the residential health and injury hazards HUD considers key targets for intervention:

**1. Allergens and Asthma:** In 2005, the CDC estimated that over 22.2 million Americans have asthma with an associated annual cost of more than \$13 billion. Asthma is now recognized as the leading cause of school and work absences, emergency room visits, and hospitalizations. For sensitized children, exposure to antigens from dust mites, certain pets, and cockroaches has been associated with more severe asthma. There is a preponderance of evidence showing a dose-response relationship between exposure and prevalence of asthma and allergies; some evidence also indicates that exposure to antigens early in life may predispose or hasten the onset of allergies and asthma. Dust mites have been identified as the largest trigger for asthma and allergies. A recently published study of children with atopic (allergic) asthma from seven major U.S. cities reported that over half of the children were allergic to cockroach and dust mite allergen (approximately 70% and 63%, respectively), with approximately 50% of the children allergic to mold (Morgan et al. 2004). Significant fractions of children also tested positive for allergy to cat, rodent and dog allergens. This is consistent with other studies that have found that cockroach tends to be the dominant allergen among asthmatic children living in the inner-city, whereas allergy to dust mite allergens appears to dominate among children living in most suburban environments. While children are the population most at risk for developing asthma, there is a growing need to address the onset of new cases in older adults, and to examine how their risk factors might differ from those of children (Selgrade et al. 2006).

Interventions known to have beneficial effects include the installation of impervious mattress and pillow covers, which can reduce allergen exposure by 90 percent. Other dust mite control measures include dehumidification, laundering bedding in hot water, specialized cleaning (dry steam or use of a HEPA vacuum), and removal of carpets and other materials that accumulate dust and are difficult to clean (e.g., dust sinks). Providing residents with education and instruction on cleaning with repeat visits by outreach workers has been shown to result in significant reduction in levels of dust mite and cockroach allergens in floor dust (Takaro et al. 2004; Morgan et al. 2004). For these same studies, researchers also reported significant reductions in asthma symptoms among children living in the intervention group when compared to the control group. A recent meta-analysis found that dust control interventions can also have a preventative effect. Based on five longitudinal studies, the researchers reported an approximately twenty percent decrease in risk of physician-diagnosed asthma for individuals in homes with dust control interventions, compared to those in control homes (Russell et al. 2007).

Interventions emphasizing the mitigation of mold and moisture problems in the homes of asthmatic children have also been shown to be effective. In one HUD-supported study, asthmatic children living in homes in which nontrivial mold growth was identified, were randomized into two groups, with one group receiving interventions to address the residential mold/moisture problems. The remediation group showed statistically significant reductions in symptom days, symptom score, and the need for acute care (Kercsmar et al. 2006). The mean cost of home interventions was \$3,458 per home, including the cost of addressing lead-based paint hazards.

Moving families with an asthmatic child into new housing designed to reduce exposure to asthma triggers has also been shown to be effective. HUD-supported research conducted by Takaro et al. (2010) demonstrated improvements in asthma symptoms and other indicators for subjects who lived in asthma-friendly Breathe-Easy Homes in addition to receiving traditional in-home asthma education and outreach. Breathe-Easy Homes address multiple asthma triggers by incorporating comprehensive enhancements into the physical structure, including moisture-reduction features, low dust-generating and chemical-emitting finishes, and advanced fresh-air ventilation systems. The authors reported significant improvements in primary (e.g., symptom-free days, FEV<sub>1</sub>) and secondary (days rescue medicine used, nights with symptoms) outcomes among BEH occupants.

**2. Asbestos:** Asbestos is a mineral fiber that has been used commonly in a variety of building construction materials and household products for insulation and as a fire-retardant. The Environmental Protection Agency (EPA) and the Consumer Product Safety Commission (CPSC) have banned most asbestos products. Manufacturers have also voluntarily limited uses of asbestos. Today, asbestos is most commonly found in older homes in pipe and furnace insulation materials, asbestos shingles, millboard, textured paints and other coating materials, and floor tiles. Elevated concentrations of airborne asbestos can occur when asbestos-containing materials (ACMs) are disturbed by cutting, sanding or other remodeling activities. Improper attempts to remove these materials can release asbestos fibers into the air in homes, increasing asbestos levels and endangering the people living in those homes. The most dangerous asbestos fibers are too small to be visible. After they are inhaled, they can remain and accumulate in the lungs. Asbestos can cause lung cancer, mesothelioma (a cancer of the chest and abdominal linings), and asbestosis (irreversible lung scarring that can be fatal). Most people with asbestos-related diseases were exposed to elevated concentrations on the job; some developed disease from exposure to clothing and equipment brought home from job sites. As with radon, dose-response extrapolations suggest that lower level exposures, as may occur when asbestos-containing building materials deteriorate or are disturbed, may also cause cancer.

Intact asbestos-containing materials are not a hazard; they should be monitored for damage or deterioration and isolated if possible. Repair of damaged or deteriorating ACMs usually involves either sealing (encapsulation) or covering (enclosure) it. Repair is usually cheaper than removal, but it may make later removal of asbestos more difficult and costly. Repairs should only be done by a trained professional certified to handle asbestos safely and can cost from a few hundred to a few thousand dollars; removal can be more expensive.

**3. Combustion Products of Heating and Cooking Appliances:** Burning of oil, natural gas, kerosene, and wood for heating or cooking purposes can release a variety of combustion products of health concern. Depending upon the fuel, these may include carbon monoxide (a chemical asphyxiant), oxides of nitrogen (respiratory irritants), polycyclic aromatic hydrocarbons (e.g., the carcinogen benzo[a]pyrene), and airborne particulate matter. Exposure to carbon monoxide, an odorless gas, can be fatal. Nitrogen dioxide can irritate or damage the respiratory tract, and sulfur dioxide can irritate the eyes, nose and respiratory tract. Improper venting and poor maintenance of heating systems and cooking appliances can dramatically increase exposure to combustion products. As the principles of “green” construction and rehabilitation become more popular, and homes become increasingly airtight to improve energy efficiency, there are concerns about potential indoor air quality trade-offs (Selgrade et al. 2006).

Experts recommend having combustion heating systems inspected by a trained professional every year to identify blocked openings to flues and chimneys, cracked or disconnected flue pipes, dirty filters, rust or cracks in the heat exchanger, soot or creosote build-up, and exhaust or gas odors. Installing a carbon monoxide detector is also recommended; however, such a detector will not detect other combustion by-products.

**4. Environmental Tobacco Smoke (ETS):** ETS (also known as secondhand smoke) results from the combustion of tobacco products and exhalation of inhaled tobacco smoke by active smokers. Tobacco smoke contains as many as 7000 individual compounds, including formaldehyde, carbon monoxide, nicotine, nitrosamines and polyaromatic hydrocarbons, with nearly 70 compounds identified as carcinogens (US DHHS, 2010; IARC, 2004). Exposure to ETS has been associated with numerous adverse health effects, including multiple types of cancer, coronary heart disease, asthma, respiratory tract infections and others. Additionally, exposure to ETS has been estimated to cause approximately 50,000 excess deaths annually in the U.S., including sudden infant death syndrome (Cal EPA, 2005). Children are particularly vulnerable to the effects of SHS. The U.S. Surgeon General's office reported that approximately 22 million children may be exposed to ETS in the U.S. (US DHHS, 2006).

Exposure to ETS can be a problem even in rooms or units where smoking does not occur. Van Deusen et al (2009) reported that levels of particulate matter (an indicator of tobacco smoke) were elevated in rooms within a home that were distant from the primary room where smoking occurred. In addition, ETS also migrates between units in multi-unit buildings. Kraev et al (2009), measured nicotine in air and air exchange rates in individual units of a lower-income multi-unit building in the Boston area and found measurable levels of nicotine in units where no smoking occurred; King et al (2010) reported similar results in nonsmoking units and hallways as part of a study in Buffalo. Wilson et al. (2010) analyzed measurements of cotinine exposure in children (an indicator of ETS exposure) and found that those living in multifamily housing had higher levels than children in detached housing, indicating the contribution from ETS migrating between units of multifamily housing. The collective confirmation on secondhand smoke infiltration into nonsmoking areas indicates that designating entire buildings or homes as nonsmoking is the only way to adequately protect nonsmoking occupants from exposure.

**5. Insect and Rodent Pests:** The observed association between exposure to cockroach antigen and asthma severity has already been noted above. In addition, cockroaches may act as vehicles to contaminate environmental surfaces with certain pathogenic organisms. Rodents can transmit a number of communicable diseases to humans, either through bites, arthropod vectors, or exposure to aerosolized excreta. In addition, humans can become sensitized to proteins in rodent urine, dander and saliva. Such sensitization may contribute to asthma severity among sensitized individuals. Insect and rodent infestation is frequently associated with substandard housing that makes it difficult to eliminate. Treatment of rodent and insect infestations often includes the use of toxic pesticides that may present hazards to occupants (see below). Integrated pest management (IPM) for rodents and cockroaches is the recommended control strategy because it minimizes the use of toxic pesticides and instead emphasizes environmental controls such as elimination of harborages, and removing access to food and water. This recommendation was recently confirmed by an expert panel that systematically reviewed the literature on this topic (Sandel et al., 2010). According to the expert panel, sufficient evidence was available to support the implementation of an IPM approach as a way of reducing pesticide residues in the home. A

reduction in residential pesticide exposure subsequently would ultimately lead to a reduction in the prevalence of pesticide-associated health issues.

**6. Lead-Based Paint and its Hazards:** Exposure to lead, especially from deteriorating lead-based paint, remains one of the most important and best-studied of the household environmental hazards to children. Although blood lead levels (BLLs) have fallen nationally, a large reservoir of lead remains in housing. Recent results from CDC's Fourth National Health and Nutrition Examination Survey (NHANES 2002) demonstrate that the national geometric mean blood lead concentration of children aged 1-5 years has decreased from 2.3 g/dL in 1991 to 1.6 g/dL in the period 1999-2002 (CDC 2005). During the 1999-2002 survey period, children aged 1-5 years had the highest prevalence of elevated BLLs (1.6%), so that approximately 310,000 children aged 1-5 years remained at risk for exposure to harmful lead levels. Overall, by race/ethnicity, non-Hispanic blacks and Mexican Americans had higher percentages of elevated BLLs (1.4% and 1.5%, respectively) than non-Hispanic whites (0.5%). Among subpopulations, non-Hispanic blacks aged 1-5 years and aged >60 years had the highest prevalence of elevated BLLs (3.1% and 3.4%, respectively). As BLLs have dropped over the years, recent analyses have examined the relationship between relatively low blood lead concentrations (<10 g/dL) and cognitive functioning in representative samples of U.S. children and adolescents, and have found evidence that suggests that deficits in cognitive and academic skills associated with lead exposure have no threshold (Lanphear et al., 2000; Canfield et al. 2003). These findings clearly support the importance of primary prevention with respect to childhood lead exposure.

Despite dramatic reductions in blood lead levels over the past 15 years, lead poisoning continues to be a significant health risk for young children. Based on results from the HUD- and NIEHS-funded National Survey of Lead and Allergens in Housing (Jacobs et al., 2002), it is estimated that approximately 40 percent of housing units (38 million) in the United States contain lead-based paint. It is further estimated that 25 percent of the nation's housing stock (24 million housing units) have one or more significant lead-based paint hazards (i.e., deteriorated lead-based paint, lead-contaminated dust, or lead-contaminated soil). 1.2 million housing units were found to pose the highest risk of lead poisoning because they housed low-income families with children under six years of age.

Among HUD grantees, lead hazard control (LHC) costs tend to range from \$500 to \$15,000 per unit, with a median cost of \$5,960. Corrective measures include paint stabilization, enclosure and removal of certain building components coated with lead paint, cleanup and "clearance testing," which ensures the unit is safe for young children. In addition, acute injuries to children have been well documented, most notably in instances involving sanding or stripping of lead-based paint or visible deterioration of lead-based painted residential building components combined with children who exhibit pica tendencies.

Evaluation of lead hazard control interventions conducted by recipients of HUD's lead hazard control grants found that interventions were effective in significantly reducing pre-intervention dust-lead levels on floors and window surfaces up to six years following intervention (Wilson et al. 2006). More intensive treatments were found to significantly reduce dust lead loadings on window sills and troughs compared to lower level treatments, however, no significant differences in dust-lead loadings on floors were reported. Sandel et al (2010) confirmed these general findings, citing that lead hazard control interventions were effective in reducing exposures to lead exposures. The authors concluded that the evidence was sufficient to promote lead hazard

control interventions as a means of reducing lead exposure and associated health effects, particularly in children.

**7. Mold and Moisture:** An analysis of several pulmonary disease studies estimates that 25 percent of airways disease, and 60 percent of interstitial lung disease may be associated with moisture in the home or work environment. Moisture is a precursor to the growth of mold and other biological agents, which is also associated with respiratory symptoms. An investigation of a cluster of pulmonary hemosiderosis (PH) cases in infants showed PH was associated with a history of recent water damage to homes and with levels of the mold *Stachybotrys atra* (SA) in air and cultured surface samples, although this association could not be considered a causal relationship. Associations between exposure to SA and "sick building" symptoms in adults have also been observed. Other related toxigenic fungi have been found in association with SA-associated illness and could play a role. For sensitive individuals, exposure to a wide variety of common molds may also aggravate asthma. A recent review by an expert committee convened by the Institute of Medicine found sufficient evidence for an association between exposure to mold and other agents in damp indoor environments and asthma symptoms in sensitized persons, upper respiratory tract symptoms, cough, and wheeze (IOM 2004). The committee also found limited or suggestive evidence for an association between damp indoor environments and the development of asthma. HUD-funded researchers recently reported a significant association between a measure of mold exposure during the 1<sup>st</sup> year of life and the diagnosis of asthma at age 7 (Reponen et al., 2011). Addressing mold problems in housing requires coordination among the medical, public health, microbiological, housing, and building science communities. Krieger et al., (2010) report that an expert panel review of relevant literature on this topic found that a combined approach of eliminating active leaks and moisture intrusion into the home while also removing moldy items already in place was an effective intervention strategy for reducing exposure to mold and associated respiratory health effects. The panel concluded that there was sufficient evidence to support implementation of a coordinated intervention strategy for mold and moisture problems.

The cost of mold/moisture-related intervention work (e.g., IPM, clean and tune furnace, remove debris, vent clothes dryer, cover dirt floor with impermeable vapor barrier) is a few hundred dollars, unless major modification of the ventilation system or structural repairs is needed. For example, in Cleveland, mold interventions, including repairs to ventilation systems and basement flooring, in the most heavily contaminated homes range from \$500 to \$5,000, with some costs also being dedicated to LHC simultaneously through its lead and asthma program.

**8. Pesticide Residues:** According to the EPA, 75 percent of U.S. households used at least one pesticide product indoors during the past year. Products used most often are insecticides and disinfectants. Another study suggests that 80 percent of most people's exposure to pesticides occurs indoors and that measurable levels of up to a dozen pesticides have been found in the air inside homes. The amount of pesticides found in homes appears to be greater than can be explained by recent pesticide use in those households; other possible sources include contaminated soil or dust that migrates in from outside, stored pesticide containers, and household surfaces that collect and then release the pesticides. Pesticides used in and around the home include products to control insects (insecticides), termites (termiticides), rodents (rodenticides), molds and fungi (fungicides), and microbes (disinfectants). In 2005, the American Association of Poison Control Centers reported that some 1.6 million children were involved in common household pesticide poisonings or exposures (AAPCC 2005). In households with

children under five years of age, almost half stored at least one pesticide product within the reach of children. Exposure to high levels of cyclodiene pesticides, commonly associated with misapplication, has produced various symptoms, including headaches, dizziness, muscle twitching, weakness, tingling sensations, and nausea. In addition, the EPA is concerned that cyclodienes might cause long-term damage to the liver and the central nervous system, as well as an increased risk of cancer. A recent expert panel review (Sandel et al, 2010) found that implementation of an integrated pest management approach was an effective intervention for reducing pesticide residues in the home and should be implemented in lieu of pesticide application for reducing pests.

There are available data on hazard evaluation methods and remediation effectiveness regarding pesticide residues in the home environment.

**9. Radon:** The National Academy of Sciences estimates that approximately 15,000 cases of lung cancer per year are related to radon exposure. Epidemiologic studies of miners exposed to high levels of radon in inhaled air have defined the dose response relation for radon-induced lung cancer at high exposure levels. Extrapolation of these data has been used to estimate the excess risk of lung cancer attributable to exposure to radon gas at the lower levels found in homes. These estimates indicate that radon gas is an important cause of lung cancer deaths in the U.S. Excessive exposures are typically related to home ventilation, structural integrity and location.

Radon measurement and remediation methods are well developed, and the EPA recommends that every home be measured for radon. Sandel et al (2010) conducted a review of the literature and concluded that active soil depressurization beneath the foundation of the structure was an effective method for reducing radon exposures in the home. EPA estimates that materials and labor costs for radon reduction in an existing home are \$800-\$2,500. Including radon resistant techniques in new home construction costs \$350-\$500, and can save up to \$65 annually in energy costs, according to the EPA.

**10. Semi-Volatile Organic Compounds (SVOCs):** Several SVOCs are emerging as potential health risks in the home due to their ubiquitous nature in consumer and building products that are produced in high volume and used worldwide. SVOCs exist partially in the gas-phase and emit their respective chemical gradually over time, particularly in the presence of increased temperatures. Two compounds of increasing concern are phthalates and polybrominated diphenyl ethers (PBDE). During recent years, phthalate and PBDE compounds have received increased scrutiny due to their potential cumulative health risks and increased use in consumer products. PBDE are found in flame retardants, plasticizers, flexible foams and may also be found in children's products. Phthalates are used as plasticizers and are most notable for their use in children's products, such as teething rings, food contact items and other flexible polyvinyl chloride (PVC)-based products. The health effect most widely associated with phthalates exposures are reproductive effects, while PBDE have shown toxicity potential in liver, thyroid and neurodevelopment systems.

Exposure to phthalates may occur via many different routes – inhalation, ingestion, water, soil – and may occur in various environments from the home to a place of work. Children are reported to have the highest exposures to phthalates among all age groups (CDC, 2005), along with lower socioeconomic status households (Zota et al., 2008). Both phthalates and PBDE have been found in house dust; exposure to dust has been reported as the primary route of exposure for PBDE

(Wilford et al., 2005; Zota et al., 2008). The presence of both phthalates and PBDE in house dust presents potential risks particularly to young children. Several house characteristics, including older age of house, water leakage and use of PVC in flooring materials, have been identified as significant indicators for potential phthalates exposures (Bornehag et al., 2005). The increased concern over phthalates and PBDE has led to increased regulatory scrutiny. In 2008, the U.S. Consumer Product Safety Commission issued a prohibition on the use of several phthalate compounds above threshold levels in children's toys and items used for childcare. Furthermore, PBDE have been banned at the state level, including in California and Washington.

**11. Take-Home Hazards from Work/Hobbies and Work at Home:** When the clothing, hair, skin, or shoes of workers become contaminated with hazardous materials in the workplace, such contaminants may inadvertently be carried to the home environment and/or an automobile. Such "take-home" exposures have been demonstrated, for example, in homes of lead-exposed workers. In addition, certain hobbies or workplaces located in the home may provide an especially great risk of household contamination.

Control methods include storing and laundering work clothes separately, and showering and changing clothes before leaving work or immediately after arriving home. Once a home becomes contaminated, cleaning floors and contact surfaces and replacing furnishings may be necessary to reduce exposures.

**12. Unintentional Injuries/Fire:** In 1997, nearly 7 million persons in the U.S. were disabled for at least one full day by unintentional injuries received at home; for children younger than 15 years of age, unintentional injury is now the leading cause of death and disability. A recent HUD-supported study of deaths among US children and adolescents from 1985 to 1997 found that an average of 2,822 unintentional deaths occurred annually from residential injuries (Nagaraja et al., 2005). The highest death rates were attributable to fires, submersion or suffocation, and poisoning. Black children were two times more likely to die from residential injuries than white children. The elderly are also at an elevated risk for residential injuries. Home visitation protocols have been shown to be effective in reducing exposure to injury hazards. The "add-on" cost of injury prevention measures, when combined with other housing interventions are estimated at about \$100 per unit. This includes the cost of some injury prevention devices (e.g., smoke alarms, electrical socket covers, etc.). DiGuseppi et al. (2010) reported on an expert panel review of seventeen interventions intended to reduce injuries due to residential deficiencies. Installed and properly working smoke detectors were determined to be an effective intervention that should be implemented for reducing fire-related injuries. In addition, the efficacy of four-sided pool enclosures and pre-set safe hot waters heaters were also deemed sufficient for reducing residential-based injuries and should be implemented on a wide scale.

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**APPENDIX B -- Relevant Publications and Guidelines**

To secure any of the documents listed, call the telephone number provided. If you are a hearing- or speech-impaired person, you may reach the telephone numbers through TTY by calling the toll-free Federal Relay Service at 800-877-8339. A number of these references are provided on HUD's CD, "Residential Lead Desktop Reference, 3rd Edition." This CD can be obtained at no charge by calling the National Lead Information Clearinghouse's (NLIC's) toll free number, 800-424-LEAD. Several of these references can be downloaded from the Internet without charge from the HUD Office of Healthy Homes and Lead Hazard Control's Internet site, [www.hud.gov/offices/lead](http://www.hud.gov/offices/lead).

**A. REGULATIONS:**

**1. Worker Protection:** Occupational Safety and Health Administration (OSHA) publications listed below can be purchased by calling either OSHA Regulations at 202-693-1888 (OSHA Regulations) (this is not a toll-free number) or the Government Printing Office (GPO) at 202-512-1800 (this is not a toll-free number). OSHA standards and other publications can be downloaded or purchased (as applicable) from OSHA's publication web page, <http://www.osha.gov/pls/publications/pubindex.list>. A broad range of information on construction and other worker protection requirements and guidelines is available from OSHA's home page, <http://www.osha.gov/> and from <http://www.osha.gov/SLTC/lead/>.

**2. Waste Disposal.** A copy of the EPA regulations at 40 CFR parts 260-268 can be purchased by calling 800-424-9346, or, from the Washington, DC, metropolitan area, 703-412-9810 (this is not a toll-free number). The regulations can also be downloaded without charge from the EPA website at <http://www.epa.gov/lead/pubs/fslbp.htm>.

**3. Lead.**

(a) Requirements for Lead-Based Paint Activities in Target Housing and Child-Occupied Facilities; Final Rule: 40 CFR part 745 (EPA) (Lead Hazard Standards, Work Practice Standards, EPA and State Certification and Accreditation Programs for those engaged in lead-based paint activities) can be purchased by calling the Toxic Substances Control Act (TSCA) Assistance Service at 202-554-1404 (this is not a toll-free number). The rule and guidance can be downloaded from the Internet without charge at <http://www.epa.gov/lead/pubs/leadcert.htm>.

(b) Requirements for Notification, Evaluation and Reduction of Lead-Based Paint Hazards in Federally Owned Residential Property and Housing Receiving Federal Assistance; Final Rule: 24 CFR part 35, subparts B through R, published September 15, 1999 (64 FR 50201) (HUD) can be purchased by calling the NLIC's toll-free number (800-424-LEAD) or downloaded without charge from the HUD website at <http://www.hud.gov/offices/lead/library/enforcement/LSHRFinal21June04.pdf>.

(c) Requirements for Disclosure of Information Concerning Lead-Based Paint in Housing, 24 CFR Part 35, Subpart A (HUD, Lead-Based Paint Disclosure Rule) by calling the NLIC's toll-

free number (800-424-LEAD). The rule, guidance, pamphlet and disclosure formats can be downloaded from the HUD website at

[http://www.hud.gov/offices/lead/library/enforcement/24CFR35\\_SubpartA.pdf](http://www.hud.gov/offices/lead/library/enforcement/24CFR35_SubpartA.pdf).

(d) U.S. Environmental Protection Agency. Lead; Identification of Dangerous Levels of Lead; Final Rule at 66 FR 1205-1240 (January 5, 2001). This rule and guidance can be obtained without charge by calling the NLIC's toll-free number (800-424-LEAD) or by calling the TSCA Assistance Service at: 202-554-1404 (this is not a toll-free number). The rule and guidance can be downloaded from the EPA website at <http://www.epa.gov/lead/pubs/leadhaz.htm>.

(e) U.S. Environmental Protection Agency. Lead; Renovation, Repair, and Painting Program; Final Rule at 73 FR 21692- 21769 (April 22, 2008). As of April 22, 2011, the rule was fully implemented. This rule and guidance can be obtained without charge by calling the NLIC's toll-free number (800-424-LEAD) or by calling the TSCA Assistance Service at: 202- 554-1404 (this is not a toll-free number). The rule and guidance can be downloaded from the EPA website at <http://www.epa.gov/lead/pubs/renovation.htm>.

## **B. GUIDELINES:**

### **1. Lead**

*Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing*; HUD. The Guidelines can be downloaded from the HUD website without charge at

<http://www.hud.gov/offices/lead/lbp/hudguidelines/index.cfm>.

*Preventing Lead Poisoning in Young Children*; Centers for Disease Control, August, 2005. These guidelines can be obtained without charge by calling the CDC toll free number at 888- 232-6789. The guidelines can also be downloaded from

<http://www.cdc.gov/nceh/lead/publications/PrevLeadPoisoning.pdf>.

*Screening Young Children for Lead Poisoning: Guidance for State and Local Public Health Officials*, November 1997; Centers for Disease Control and Prevention (CDC). These guidelines can be obtained without charge by calling the CDC toll free number at 888-232-6789 or they can be downloaded from <http://www.cdc.gov/nceh/lead/guide/guide97.htm>.

### **2. Green Building**

American Lung Association of the Upper Midwest. *Health House Builder Guidelines*. Available: <http://www.healthhouse.org/build/2008HHbuilderguidelines.pdf>.

U.S. Department of Energy. *Builders Challenge: Requirements for Builders*. Available: <http://www1.eere.energy.gov/buildings/challenge/requirements.html>.

Enterprise Community Partners. *Green Communities Criteria*. Available: <http://www.greencommunitiesonline.org/>.

National Association of Home Builders. *Green Building Program*. Available: <http://www.nahbgreen.org/>.

U.S. Environmental Protection Agency. *Energy Star: Indoor Air Package*. Available: [http://www.energystar.gov/index.cfm?c=bldrs\\_lenders\\_raters.nh\\_iap](http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_iap).

U.S. Green Building Council. *LEED for Homes*. Available: <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=147>.

## **C. REPORTS:**

### **1. Lead**

Putting the Pieces Together: Controlling Lead Hazards in the Nation's Housing, (Summary and Full Report); HUD, July 1995. A copy of this summary and report can be purchased by calling 800-245-2691 toll free or downloaded from <http://www.cdc.gov/healthyplaces/healthyhomes.htm>

President's Task Force on Environmental Health Risks and Safety Risks to Children. *Asthma and The Environment: An Action Plan to Protect Children*. Washington, DC 1999.

Preventing Lead Poisoning in Young Children, A Statement by the Centers for Disease Control and Prevention, Atlanta, GA, August, 2005. Can be downloaded from the Internet without charge at <http://www.cdc.gov/nceh/lead/publications/prevleadpoisoning.pdf>.

### **2. Healthy Homes**

Healthy Housing Reference Manual; HUD/CDC, 2006. A copy of this manual can be downloaded from the CDC website without charge at [www.cdc.gov/healthyplaces/healthyhomes.htm](http://www.cdc.gov/healthyplaces/healthyhomes.htm).

The Healthy Homes Initiative: A Preliminary Plan (Summary and Full Report); HUD, July 1995. A copy of this summary and report can be downloaded from the HUD website without charge at [www.hud.gov/offices/lead](http://www.hud.gov/offices/lead).

Institute of Medicine. *Damp Indoor Spaces and Health*. The National Academies Press. Washington, D.C. 2004.

Institute of Medicine. *Indoor Allergens. Assessing and Controlling Adverse Health Effects*. The National Academies Press. Washington, D.C. 1993.

National Research Council and the Institute of Medicine. *Ethical Considerations for Research on Housing-Related Health Hazards Involving Children*. The National Academies Press. Washington, D.C. 2005.

Natural Resources Defense Council. *Our Children at Risk*. Washington, D.C. 1997. Can be ordered from the Internet from [www.nrdc.org](http://www.nrdc.org).

Pleis Jr., Lucas JW, Ward BW. *Summary health statistics for U.S .adults: National Health Interview Survey, 2008*. National Center for Health Statistics. Vital Health Stat 10(242). 2009.

Bloom B, Cohen RA, Freeman G. *Summary health statistics for U.S. children: National Health Interview Survey, 2008*. National Center for Health Statistics. Vital Health Stat 10(244). 2009.

U.S. Department of Health and Human Services. *How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2010.

U.S. Department of Health and Human Services. U.S. Department of Health and Human Services. *The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2006.

U.S. Environmental Protection Agency. 2009. Phthalates Action Plan. [http://www.epa.gov/oppt/existingchemicals/pubs/actionplans/phthalates\\_ap\\_2009\\_1230\\_final.pdf](http://www.epa.gov/oppt/existingchemicals/pubs/actionplans/phthalates_ap_2009_1230_final.pdf) Accessed August 4, 2011.

California Environmental Protection Agency. 2005. *Proposed Identification of Environmental Tobacco Smoke as a Toxic Air Contaminant. Part B: Health Effects*. Sacramento (CA): California Environmental Protection Agency, Office of Environmental Health Hazard Assessment.

CDC. 2005. Centers for Disease Control and Prevention. *Third National Report on Human Exposure to Environmental Chemicals*. <http://www.cdc.gov/exposurereport/>. July 2005.

International Agency for Research on Cancer. *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Tobacco Smoke and Involuntary Smoking*. Vol. 83. Lyon (France): International Agency for Research on Cancer, 2004.

#### **D. PAPERS**

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**APPENDIX C: Resources for Designing and Implementing Healthy Homes Projects**

HUD encourages applicants to incorporate the following elements in designing, implementing and evaluating a project for the assessment and remediation of housing-related environmental health and safety hazards that result in illnesses to children.

For each activity that you incorporate, you will need to collect standardized data, as applicable to your project. These data may include pre- and post-intervention information (e.g., environmental sampling, housing conditions, educational or training information, and health outcome data).

HUD strongly encourages applicants to use data collection instruments that have been used extensively in the field and subjected to validation. You must also keep detailed records of costs associated with project activities to quantify the cost effectiveness of desired outcomes.

Examples of data collection instruments and sources of best practices include:

**1. Asthma and Other Respiratory Hazards**

The “Home Environmental Checklist” and specific protocols used by Public Health – Seattle & King County at:

<http://www.kingcounty.gov/healthservices/health/chronic/asthma/resources/~media/health/publichealth/documents/asthma/CDCHomeEnvironmentalChecklist.ashx>

The environmental assessment survey for asthma/respiratory health developed for use in public housing (may also be appropriate for general multifamily housing) by the “Healthy Public Housing Initiative” at: [www.hsph.harvard.edu/hphi/surveytraining.HTM](http://www.hsph.harvard.edu/hphi/surveytraining.HTM).

The American Academy of Pediatrics (AAP) instrument for assessing childhood asthma, available from AAP at: [www.aap.org/research/instrumentoutcome.htm](http://www.aap.org/research/instrumentoutcome.htm).

The National Healthy Homes Training Center and Network “Pediatric Environmental Home Assessment (PEHA)” instrument designed for public health and visiting nurses, available at: <http://www.healthyhomestraining.org/Nurse/PEHA.htm>.

EPA’s Indoor Environments Division-sponsored Asthma Health Outcomes Project (AHOP), which identified the common components of effective asthma intervention programs, available at: [http://cmcd.sph.umich.edu/assets/files/final\\_AHOP\\_report.pdf](http://cmcd.sph.umich.edu/assets/files/final_AHOP_report.pdf).

The EPA-sponsored Communities in Action for Asthma-Friendly Environments (CAAFE), a forum for exchanging asthma intervention program best practices through a peer to peer online network, which includes change concepts to evaluate asthma program progress, available at: [www.asthmacommunitynetwork.org](http://www.asthmacommunitynetwork.org)

## 2. Home Injury Hazard Assessment

The healthy home checklist that includes a childhood (and elderly) injury assessment instrument, on the OHHLHC's web site under "Healthy Homes Program Resources" at: [www.hud.gov/offices/lead/hhi/hhiresources.cfm](http://www.hud.gov/offices/lead/hhi/hhiresources.cfm).

The results of the National Council on Aging's "Creative Practices in Home Safety Assessment and Home Modification Study" highlights fall prevention practices for seniors at: <http://www.healthyagingprograms.org/content.asp?sectionid=69&ElementID=568>

## 3. Mold and Moisture Assessment and Intervention

The mold and moisture assessment tool developed by the Cuyahoga County Department of Development is available on the OHHLHC's web site under "Technical resource materials" at: [www.hud.gov/offices/lead/hhi/hhiresources.cfm](http://www.hud.gov/offices/lead/hhi/hhiresources.cfm).

The "Home Moisture Audit" is available from Environmental Health Watch at: <http://www.ehw.org/wp-content/uploads/2011/01/Home-Moisture-> The tested mold and moisture home interventions available from Environmental Health Watch at: <http://www.ehw.org/wp-content/uploads/2011/01/Moisture-Control-Treatments-in-Older-Housing.pdf>.

EPA's "A Brief Guide to Mold, Moisture, and Your Home" EPA 402-K-02-003, 2002 Available: <http://www.epa.gov/mold/moldguide.html>; and <http://www.epa.gov/mold/pdfs/moldguide.pdf>  
Also available in Spanish: [http://www.epa.gov/mold/pdfs/moldguide\\_sp.pdf](http://www.epa.gov/mold/pdfs/moldguide_sp.pdf).

The WHO Guidelines for Indoor Air Quality: Dampness and Mould; ISBN 798 92 890 4168 3, 2009, available from: Publications; WHO Regional Office for Europe; Scherfigsvej 8; DK-2100 Copenhagen O, Denmark; or <http://www.euro.who.int/document/E92645.pdf>.

*Recognition, Evaluation, and Control of Indoor Mold*, Edited by Bradley Prezant, Donald M. Weekes, and J. David Miller; Product ID: 2008; IMOM08-679; ISBN: 978-1-931504-91-1  
American Industrial Hygiene Association, 2700 Prosperity Ave., Suite 250, Fairfax, VA 22031  
[https://webportal.aiha.org/Purchase/ProductDetail.aspx?Product\\_code=3f9e0a5a-4778-de11-96b0-0050568361fd](https://webportal.aiha.org/Purchase/ProductDetail.aspx?Product_code=3f9e0a5a-4778-de11-96b0-0050568361fd).

## 4. Integrated Pest Management (IPM)

Guidance on IPM interventions is available from the U.S. Environmental Protection Agency's web site at [http://www.epa.gov/oppfead1/Publications/Cit\\_Guide/citguide.pdf](http://www.epa.gov/oppfead1/Publications/Cit_Guide/citguide.pdf), and related web pages.

*Northeastern IPM Center's Integrated Pest Management for Multifamily Housing*;  
<http://www.stoppests.org/>.

USDA's National Institute of Food and Agriculture;  
<http://www.csrees.usda.gov/nea/pest/pest.cfm>.